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PROGRESS IN AERODYNAMICS AND AIRCRAFT DESIGN IN THE
UKRAINE IN 1920-1930

Stephan G. Prociuk

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Progress in Aerodynamics and Aircraft Design
Ukraine in 1920-1930

Stephan G. Prociuk

SUMMARY. The author presents a review of developments in Ukrainian science in the 1920's and early 1930's. He is particularly concerned here with Ukrainian scientists in the fields of aeronautics and aircraft designing. He emphasizes that many Ukrainian scientists were first active in Moscow in TsAGI (The Central Aerohydrodynamic Institute). The point is made that many famous scientists, such as Lobach-Zhuchenko, Zhuravchenko, Horoshchenko, Kalinin, and Proskura, were Ukrainians and not Russians. The development of aviation schools (especially in Kharkov and Kiev) and factories is also discussed.

Information abroad concerning achievements of Ukrainian science has always /72* been at a low level. The only exception to this is the second half of the 1920's and partly the beginning of the 1930's, when Soviet power in the Ukraine at that time displayed some initiative in this area. As far as technical studies are concerned, their status improved only at the very end of the Twenties with the beginning of the publication of serious technical journals, at that time mostly in Kharkov.¹

*Numbers in the margin indicate pagination in the foreign text.

¹There were not as many of these journals as one might think. We shall mention such monthlies here: "Scientific-Technical News" [*Naukovo-Tekhnichnyy Visnyk*] (from 1926), "Agricultural Machinery" [*Sil'sko-hospodars'ka mashyna*] (since 1926), "Problems of Heat Technology" [*Problemy Teplotekhniky*] (since 1927), "Ukrainian Silicates" [*Ukrains'ki sylikaty*] (since 1926), "Construction" [*Budivnytstvo*] (since 1929), "Agriculture and the Food Industry" [*Sil'sko-hospodars'ka ta kharchova promyslovist'*] (since 1930), "Machines and the Farm" [*Mashynanasei*] (since 1930), "Technology for the Masses" [*Tekhnika masam*] (bi-weekly, 1930). Besides this, as early as 1923 organs of Ukrainian establishments were published in the Ukraine in the Russian language, e.g., "Coal and Iron" [*Ugol'i zhelezo*] (the organ of Donugol', Yugostal' and YuRT), or "The Engineer Worker" [*Inzhenernyy rabotnik*] (the organ of the All-Ukrainian Bureau of the Engineering-Technological Section of the Mining Union).

In deed, it was not until 1934-1937 that the State Technical Publishing House [Derzhtekhvydav] of the Ukraine was able to publish a number of noteworthy books in the Ukrainian language as well as translations from foreign languages. The activity of such very worthy Ukrainian publishing houses as "The Ukrainian Worker" [Ukrains'kyi Robitnyk], The State Work Publishing House [Derzhtrudvydav] or DVU ("The Workers Library" [Robitnycha Biblioteka]), which accomplished the publication program in 1928-1932, occurred first of all in the field of the publication of technical books of a popular nature as well as handbooks for workers in industry.

Cruel oppression of publishing concerns in the Ukraine began in 1930, including among its victims technical publications and particularly periodicals of which none lasted beyond the fateful year of 1933. In 1935-1937 there was a brief rebirth of the publication of technical books in the Ukrainian language, but in general the dark age of complete suppression of Ukrainian technical publications from 1933 continues to this day. The minimum quantity of such technical books which appeared in print in 1958-1967 (we have in mind books in Ukrainian) does not change the picture.³

This in no way means that Ukrainian technical science declined. On the contrary, it grew very rapidly, but approximately from 1955-1957 it was represented almost exclusively by publications in the Russian language. A number of scientific-research institutions of a technical nature in the Ukraine published its journals or semi-periodical collections (these are chiefly what are known as republican, interdepartmental, thematic collections which appear irregularly, usually at least two to six times a year). Ukrainian authors are also widely represented in all the more

²In 1929-1934, the State Technical Publishing House, more specifically, its so-called All-Ukrainian Branch.

³For more specific information on the production of Ukrainian scientific literature in the sixties in the USSR, see the notes of the author: "Coordination of Scientific-Publication Activity in the USSR in 1964-1965" *Ukrains'ke slovo* [Ukrainian Word], (Paris), Nos. 1242, 1243, 1244 and 1245, August 29, 1965, etc. "The Shortsightedness of Russification Oppression", *Ukrains'ke slovo*, (Paris), Nos. 1283, 1284, 1286, June 12, 19 and 26, and July 3, 1966.

important technical All-Union journals. Thus, it now becomes easier to see the contributions of Ukrainian scientists to the development of science. This can even be clearly seen in spite of the fact that almost all the scientific production of literature on natural science and technology now appears in the Ukraine in the Russian language. To conduct such an analysis in 1933-1956 was still unusually difficult, and frequently impossible. But even in 1929-1932, in the period of Ukrainianization, in the USSR they had already begun to conceal the achievements of Ukrainian scientists and technicians. There was a wide-spread practice of including them in the ranks of Russian specialists, never emphasizing their connections with the Ukraine. /73 Therefore, when, according to the existing tendency, somewhat more works on the history of technology appeared separately from the technology of the USSR, the role of Ukrainian engineers, researchers and specialists in this history emerges diminished, unclear and silenced. In order to comprehend this role, it is necessary to investigate in detail all scientific and technical research and publication activity in the USSR, especially in the years 1930-1939. This period is especially important for the reason that, in these years, a new, young generation comes into the arena, a generation which, during the revolution, was in its teens or even younger, but which produced the most brilliant inventors and researchers of new technology. This generation became the teachers of the present powerful incursions of our scientists.

In our article we are interested only in aircraft construction. We shall limit ourselves also to an analysis of the achievements in the Twenties and Thirties, and we shall show that in these years there already were educated and active young engineers and scientists in the technical studies who soon became world famous in the development of technology. Many of them achieved very high posts, some have already departed from us forever; many of them were

written about a great deal in socialist and foreign publications. But, these sources rarely indicate that all of them are, in fact, Ukrainian scholars.⁴

For purposes of order and introduction, it must be noted that in the very early Twenties, the possibility of working in the area of aerodynamics or aircraft construction existed mainly in the "Center", that is, in Leningrad and Moscow. The Ukraine was destroyed to a great extent by World War I and the Revolution, and from 1920 to 1925 it was concerned with rebuilding. Aircraft construction was then entirely in its infancy, and State organizations were able to give it only limited attention and only in places which were "near at hand" to this authority. Therefore, the first Ukrainian aviation researchers had to be sought in Moscow rather than in the Ukraine itself.

In the pleiad of our researchers, such names stand out as: B. M. Lobach-Zhuchenko, V. L. Moysiyenko, E. Tatarchenko, N. D. Anoshchenko, N. Tur-Turchenko, F. Kotlyarenko, N. Yatsuk and V. Chernyak. In 1920, F. L. Moysiyenko worked in the wartime literature division at the so-called Revolutionare War Council (RVSR) in Moscow, and as early as 1921 he published a brochure entitled "Overall Dimensions of Aircraft" [*Predel'nye razmery samoletov*], in which he investigated aerodynamic conditions of the flight of aircraft with various geometric wing designs and their effect on maximum aircraft payloads. In his work, Moysiyenko also touched upon the maximum speeds for aircraft at a given maximum load as a function of mechanical properties of contemporary materials and construction designs of aircraft. In this same year, Moysiyenko published a second work entitled "A Study of the Economics of Air Communication"

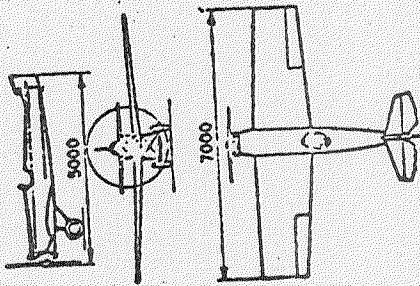
⁴In one of the latest releases of "Outlines from the History of Technology and Natural Science" (No. IX, Kiev, p.6, 1967) K. K. Khrenov informs us in his article on the work of members of the Section of Aviation History of the Ukrainian Division of the Soviet National Union of Historians of Natural Sciences and Technology (Chairman, M. A. Kochehura; Secretary, Ye. B. Korol'ova) on the monograph entitled, "The Development of Aviation in the Ukraine," which is already prepared for publication. We have some doubts whether this work will appear very quickly upon library shelves. We also think that many data and details will be lacking. An example is the very curt and insufficient manner in which they treated this matter in the Ukraine in the newspaper, "The Youth of the Ukraine" [*Molod'Ukrainy*] (Kiev, 19 January 1968) dedicated to the development of aircraft construction in the Ukraine in the period prior to the First World War (the work of O. Mozhays'kyy, O. Mykulyn, S. Hryzodubov and others).

[*Doslidzhennya ekonomichnosti povitryanogo zv'yazku*].⁵ In 1923 he wrote a new brochure, "Simplified Grapho-analytical Aerodynamic Analysis of Aircraft" [*Grafo-analitychna sproshchena aerodynamichna analiza litaka*], and as an addenda to the journal, *The Military Air Fleet* [*Voennovozdushnyy Flot*] (henceforth referred to as VVF), he described the DN-4 aircraft (with the Fiat A-12 motor).

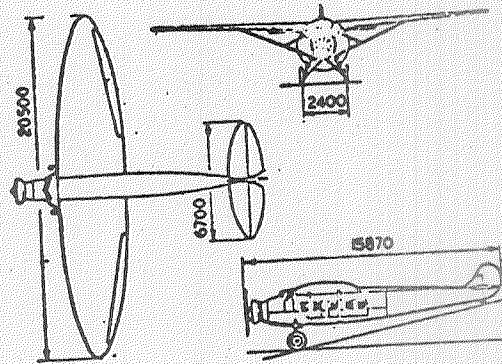
Active at the same time was the well-known engineer-researcher B. M. Lobach-Zhuchenko. In 1921 he published a handbook entitled *Aviation Motors* [*Aviatsionnye dvigateli*] (Part one, State Publishing House, Division of War Literature of RVSR). His work increased as years went by. In 1924 Lobach-Zhuchenko (then already a professor at the Moscow Aviation Institute) published a second book, *The Development of Aircraft Engines and Their Present Status* [*Razvitie aviatsionnykh dvigateley i ikh sovremennoe sosstoyanie*]. The Aviation Publishing House [*Aviaizdat*] published his book on fundamental naval aviation in 1925, and in 1926 his *Short Descriptive Course on the Internal Combustion Engine* [*Korotkyy opysovyy kurs po dvigunam vnutrishn'oho zhorannya*]. A series of brochures by Lobach-Zhuchenko were published by ODVF (Moscow) including "Current Aircraft Engines and Their Development" (1924) [*Suchasni aviyatsiyni dvyguny ta ikh vyrobnytstvo*], "The Aircraft Engine, its Construction and Uses" (1925) [*Aviyadvygun, yoho pobudova ta zastosuvannya*], and the popular brochure "What is an Aircraft Engine, How is it Built and How Does it Work?" (1925) [*Shcho take aviyatsiynny dvygun, yak vin pobudovanyy ta yak pratsyuye?*]. It is evident that Professor Lobach-Zhuchenko provided basic educational disciplines in the development and construction of aircraft engines in the USSR. In fact, he was also active later in 1927-1928 when the Osoaviakhim Publishing House issued his next book on his speciality, *Aviation Motors, their Design, Operation and Development* [*Aviyamotory, ikh pobudova, pratsya ta vyrobnytstvo*].

⁵If we did not clearly indicate that this work was published in Ukrainian, it must be understood that it was published in Russian. For the Ukrainian reader we most frequently will provide the titles of these works in the Ukrainian translation.

Plans of Aircraft by Ukrainian Designers in the 1920's

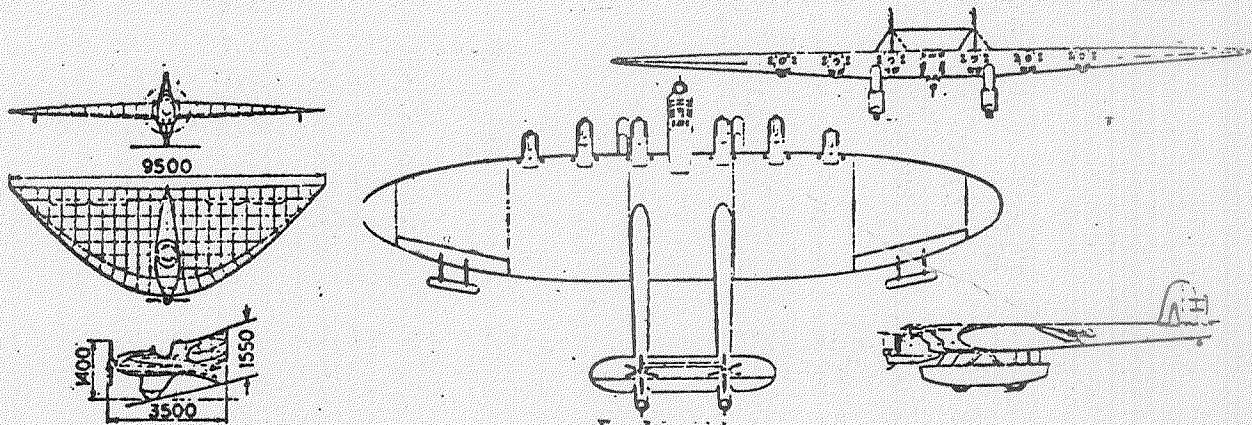


1923, the VOP aircraft by Viktor Osypovych Pysarenko



1929, the K-5 Aircraft designed by Konstantin Oleksiyevych Kalinin

KALININ K-7



1926, BIC-3 Aircraft by Borys Ivanovych Cheranovs'kyi

1923-1933, Giant K-7 Aircraft designed by the Bureau of K. O. Kalinin

E. Tatarchenko was, in the first place, the author of many articles in the journals *Military Air Fleet* (VVF) [*Voennovozdushnyy Flet*] and *Samolet* [The Airplane], especially in the years 1924-1925. The most important of these were "The Symbolic Marking of Categories of Aircraft" [*Symvolichne poznachennya kategori povitryanykh korabliv*], "Inverse Flight on the Back of the Aircraft" [*Obernenyy pol'ot na spyni litaka*], "Mobile Airbases" [*Pere-dvyzhni aerobazy*], "Aviation Accidents, their Causes and Control" [*Aviyatsiyni avarii, ikh prychyny ta borot'ba z nymy*], "The Paris Air Show, 1925" [*Parish-s'kyy aerosalon 1925*], "The Military Air Fleet of Japan" [*Voyenno-povitryana flota Yaponii*], and others. After an interval from 1926-1929, the reason for which is not known by us, articles by Tatarchenko again appeared in aviation journals in 1930, including views on the air fleets of the British Empire and France (VVF). As will be shown later in our article, the majority of researchers who became well-known in the years 1921-1924 continued their work into the Thirties. For example, Moysiyenko published new works in 1931, cf. *Technology of the Air Fleet* [*Tekhnika Vozdushnogo Flota*] (henceforward referred to as TVF), No. 3, 1931. /75

N. D. Anoshchenko, a well-known pilot of his time, wrote for the journal *Air Navigation* [*Vozdukhoplavanie*] during 1924-1925. Later, in a separate book he published a series of articles on airplanes and dirigibles, and also a series of brochures such as "People in the Air" (1923) [*Lyudy v povitri*], "Free Balloons" (1924) [*Svobodni aerostaty*], "What is an Air Fleet?" (1925) [*Shcho take povitryana flota?*]. He also published one of the first books on designing flying models and gliders (floaters) in *Military News* (1924) [*Voenny vestnik*].

A serious, but beginning researcher in the field of aircraft engines was F. Kotlyarenko. He published a series in several issues of VVF, a larger work on gasoline engines (in 1924), and a further article on a similar theme in the journal "The Airplane" (Nos. 6-7, 1924 and No. 3, 1924). Undoubtedly an interesting booklet is that of N. Yatsuk on the technology of the air fleet (issued by the Military Publishing House in 1925), and the brochure and tables by N. Tur-Turchenko on the diagnostics of defects in engines (Gostekhizdat, 1926). Of V. Chernyak, we know only that he was an instructor in the aviation

schools of the VVF during 1924-1925, but he was mainly interested in the disciplines of a socio-political nature.

There is no doubt that such specialists as B. M. Lobach-Zhuchenko, V. L. Moysiienko, F. Kotlyarenko, and also E. Tatarchenko and N. D. Anoshchenko can be included among the pioneers of aircraft design during early post-war years. This was only the beginning. It is important to note that even then in the western technologically developed nations, aircraft construction was only making its first serious steps. Usually, aircraft construction matters rapidly began to attract an ever larger circle of enthusiasts, and primarily it began to establish a scientific basis. Specialists of the physical-technical sciences began research on questions of design and aircraft technology in scientific-research laboratories and in wind tunnels. From 1926 to 1929 the nature and quality of work on aircraft construction changed sharply. Furthermore, scientists of note became basic founders of aerodynamics and generally of contemporary aviation technology.

Among the Ukrainian scientists appear the names H. F. Proskura, D. N. Ksandrov, K. A. Kalynyn,⁶ S. V. Serensen, A. Heronimus, S. V. Gerngros and such world famous names as S. P. Korol'ov and O. K. Antonov.⁷ Karkov was the

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⁶This name was written thus in the Twenties, not it is written K. A. Kalinin. In accordance with newest data, Kalinin was repressed in the Fall of 1938 and died (or perished) 21 April 1940. In 1937-1938 he designed war planes primarily; thus in 1937 his collective built the first tailless bomber (K-12), and in 1938 he designed a bomber of the usual type with an aft combustion point (K-13).

⁷It is known in the USSR as well as abroad that S. P. Korol'ov was an ardent Ukrainian, as were other famous scientists in the USSR. The statements of certain emigrant workers (see for example, "Svoboda" of February 20, 1968) that S. P. Korol'ov is called a Russian scientist in the USSR are not well founded. On the contrary, in such serious periodicals as the "Journal" [*Vestnik*] of AN USSR and other official sources it is always noted that Korol'ov was a Ukrainian. Our treatment of O. Antonov was unnecessarily careful (the author of this article has made such an error in the past himself). Even though Antonov was born in Russia, he considers himself a Ukrainian scientist and presents himself as such. In the brochure "Science in the Ukraine" (published by Mistetstvo, Kiev, 1963) the author, in writing about the high-speed airliner An-10, states clearly that it was designed by "The famous Ukrainian aircraft designer, O. K. Antonov". It is also characteristic that Antonov is a member of the Ukrainian Academy of Sciences, but not of the All-Union Academy of Sciences in Moscow.

main center for the development of research on hydro- and aero-dynamics, aerosuitability and aircraft construction. The Scientific-Research Department of Hydromechanics and Aviation was organized at the Kharkov Technological Institute, (KhTI), and headed by the brilliant scientist, an academician of VUAN, H. F. Proskura. A group of other noted researchers quickly gathered at this department. An aviation section was also created at the KhTI which, in 1925, issued the first detailed handbook by Professor Proskura for students of VYSh entitled *Theoretical Fundamentals of Aviation and Airflights* (in two parts). Also in 1925 Professor Proskura published his interesting work on the reserves of resistance of light weight gliders and aeroplanes⁸ (in a collection of articles on test studies of All-Union glider

In spite of a certain objectivity in relation to correct nationality (or national origin) of aviation specialists in Soviet sources, we shall, nevertheless, frequently mention the attempts to conceal the nationality of famous designers and scientists, or worse, to call them Russians. A recent example is the article by P. Astashenkov on the early life of S. P. Korol'ov entitled "The Rising Stream" [*V voskhodyashchem potoke*], *Aviation and Astronautics* [*Aviatsiya i kosmonavtika*], Nos. 10, 11, and 12, 1968. In this long article Astashenko fails to mention that Korol'ov was a Ukrainian. On the contrary, he speaks in excess about the friends of Korol'ov of the time - the Russians, S. N. Lyushin, K. K. Artseulov and others. Furthermore, he shows that the design and aviation activity of Korol'ov in his younger years was possible only in the "company" of Russian enthusiasts in this field.

Another classic example of subtle Soviet falsification is the reference book of S. I. Seleshnykov: "*Astronomy and Astronautics*" [*Astronomiya i kosmonavtika*], (Kiev, "Naukova Dumka", 302 pp, 1968). Ukrainian scientists in this book are mainly called "Soviet", whereas the Russians are simply called "Russian", and more particularly, Soviet Russian is applied to scientists whose last names, first names and even their birth places speak clearly that they were foreigners (for example, P. K. Sternberg, F. A. Tsander, O. Yu. Schmidt, G. A. Shayn, Ya. I. Perlman, L. I. Mandelstam, B. K. Ionnisiani, N. I. Idel'son and many others). Therefore, it must be noted that Seleshnikov's book is basically a valuable and beneficial book, even though there appear such curiosities as when Avenir O. Yakovkin is called "a Ukrainian and Russian(!) Soviet astronomer", but the nationalities of Kondratyuk and Ambartsumyan, and of many others, are not noted.

⁸In the publications of 1924-1931 the term "*aeroplyan*" [aeroplane] was used more frequently than the current word "*litak*" [airplane] (or Russian, "*samolet*" [airplane]).

contests, published by Aviyakhim in Moscow). In the early Twenties extensive activity, along with Professor Proskura, was already taking place among such scientists at Kharkov as S. V. Gerngros, A. Heronimus, B. P. Gerasimovich and D. N. Ksandrov.

S. V. Gerngros published his first work as early as 1918 when he worked in the Aviation Calculator-Experimental Bureau at MVTU (The Moscow Higher Technical School, later named after Bauman). This was the brochure entitled, "A Follow-up Analysis of the Single-Seat Biplane 'Vickers-Scout'." In 1922 Gerngros published tables of probable coefficients of useful propeller action (Proceedings of TsAGI, Nos. 1 and 8, NTU-VSNKh). In 1924 Gerngros lectured his students at the Department of Aviation of KhTI on the dynamics of aeroplanes. The Aviation Section of KhTI published his lectures in 1925. In these lectures take-off and landing problems of planes are investigated, as well as flights in closed curves, figure-acrobatic flights, and the construction strength of the aircraft.

A. Heronimus, who had also come to Kharkov, published an article in 1925 on chronometric speed of planes (VVF, No. 10). B. P. Gerasimovich gave a course on theoretical aerodynamics (Aviation Section of KhTI, 155 pp, 1925) which, at that time, noted some very positive evaluations. The widely developed pedagogical and research work in 1924-1925 produced quickly noticeable results, which are reflected, among others, in the activity of the Ukrainian Scientific-Technological Association established 9 December 1927 (UNTT), in particular the Kharkov Division of UNTT, and its section on aviation (established 17 February 1929). In this section the active members were all the noted professors of KhTI, together with H. F. Proskura, Ya. L. Heronimus, D. N. Ksandrov and such already well-known designers as F. A. Kalinin, I. Neman, M. I. Nestruev and others.

One of the greatest achievements of the Kharkov group (school) of aviation is that it existed as a "Ukrainian" school, and it also published largely in the Ukrainian language. From 1927 to 1930 Ukrainian scientists and engineers published many brilliant works on aerodynamics and aviation design in the organ

of UNTT - "Scientific-Technological News". Also, lectures of this section of aviation of UNTT and the Seminar on aerodynamics were given in the Ukrainian language.⁹

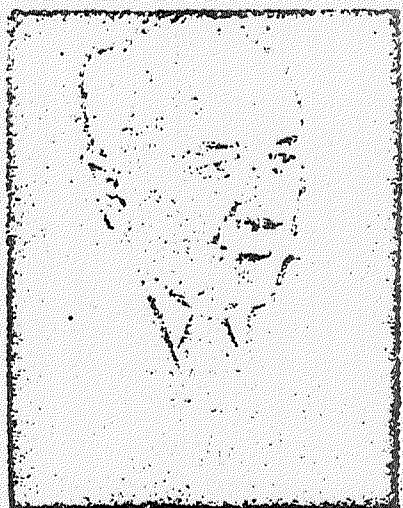
Especially worthy of note is Professor D. N. Ksandrov. In 1925 his course at KhTI, "Aerodynamic Analysis of Aircraft" was still published in Russian, but in 1929-1930 he published valuable works in Ukrainian, which lent much weight to the science of aerodynamics as well as to Ukrainian aviation terminology. The most important of these works were: "An Economic Calculation of Airplanes", "A Discussion on the Development of the Theory of the Airplane Wing", and "Nomograms of Aerodynamic Calculation". In the first work Professor Ksandrov analyzes the question of maximum particular stress and fuel supply at a given speed. The author illustrates his analysis with examples of Fokker, Junkers G-24-L, Sikorsky-37 and Potez operational aircraft. He published a second work, a scientific critique of the wing theory proposed by the German researcher Herman Borke. The theory depended upon analyzing the stress of the plane in the air on the basis of the whirlwind theory, in accordance with which an increase in the speed of the air below corresponds to the acceleration of the air of the propeller current in the direction of the axis. The acceleration of air in the direction of flight corresponds to the tangential acceleration of the propeller current. Lateral acceleration of air corresponds to the radial acceleration of the propeller current. Professor Ksandrov did not agree with the theory of Borke; therefore, he supported the inductive wing theory of Prandtl. While investigating the differences between the formulas of Borke and Prandtl, Professor Ksandrov also touched upon important questions of air currents on the surface of the wing (boundary layer flow), which today play an important role in aerodynamic calculations of supersonic and hypersonic aircraft. /77

⁹The lectures encompassed a wide range of disciplines, as for example, the characteristics of the complex wing, calculations of multi-engined aircraft, aviation materials, description and data of the wind tunnels of KhTI, reasonable measurements of aircraft and others. It is characteristic that the plan of lectures already included even then (1930) the subject of interplanetary connections and of jet flight principles.

Interesting and important is Ksandrov's work on nomographs of aerodynamic calculation, which was printed in several issues of the "Scientific-Technical News" in 1930-1931. Ksandrov contributed a great deal to the nomographs of Everling, which made it possible to determine the coefficient of flight speed (in the German original - Schnellflugzahl), flight distance (Weitflugsahl), and the so-called construction coefficient (= the particular stress of weight upon the unit of force, multiplied by the root of the particular stress per square meter of the wing surface). The nomographs of Eberling-Ksandrov help to quickly find the possible height of the flight ceiling, the takeoff speed and the productivity coefficient (Θ) of the propeller for a given aeroplane. It is interesting to note that by analyzing these nomographs, Ksandrov noted and corrected an error in Everling's calculations, which was included in the inaccurate identification of the magnitude of equations $s - 750N/G - kv_1$ and $\Theta/K = v_1G/75N$. The first equation agrees with the regime of lift with the speed w (m/sec), and the second with the regime of the flight level, and therefore, Θ of the first equation does not equal Θ of the second equation. In his work, Ksandrov also questioned the interpretation of experimental data by other contemporary researchers, such as Herman, Lindberg and others.¹⁰

In Ukrainian technical literature of 1929-1930 there appeared other valuable works on aviation such as the work of H. F. Proskura on the theory of flow without side pressure. Even though this study concerns water flow, by analogy it can be adapted to calculations of any current. Academician

¹⁰Professor Ksandrov also concerned himself with economic questions of aircraft construction as in his work, "On Economic Calculations of Airplanes" [*Do ekonomichnoho rozrakhunku aeroplaniv*] (NTV, Nos. 5-6, pp. 137-142, 1929), and also with questions of pneumatic transport (NTV, No. 9, pp. 205-211, 1929).



Georgiy Fedorovich Proskura
(1876-1958)

Proskura proposed the thesis that the coefficient of current loss depends mainly on the law of the distribution of velocities in the cross section of the stream before overflow, on the form of the overflow edge, and on the state of the previous wall of overflow near the very edge. To establish his thesis, Proskura depended in detail upon new (at that time) studies of Hailer, Boussinesq and Rehbock.¹¹

The encompassing work of O. Borysenko, entitled "The Selection of Airplane Wings" is considered extremely important. This work is in far greater detail and more scientifically founded than similar works of the Russian engineers V. L. Nikitin and V. S. Pashnov, who had criticized Borysenko. On the other hand, Borysenko leans upon the results of studies by his colleague, the Ukrainian designer, P. V. Dybsiky, who discovered the optimum strength requirements and aerodynamic characteristics concerning wing lengthening of cruising monoplanes.

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The then young engineer I. T. Shvets, having been on an assignment abroad, informed the Ukrainian technical society about methods for producing turbine blades at the turbine plant "Wumag" at Goerlitz (Germany), and about starting and regulating the turbines at this plant. Ivan Trokhymovych Shvets critically pondered the technology of producing stamped blades, milled blades and also nozzles and directional blades. This was the beginning of a brilliant career for I. T. Shvets, who later (1950) became an academician of the Academy of Sciences of the UkSSR [AN UkSSR], the rector of the University of Kiev, and

¹¹We do not mention here a number of new works by Academician Proskura, which he was forced to publish in Russian, for example, "Centrifugal Pumps" [*Centrobeznoye Nasosi*] (Kharkov, 1930), "Experimental Hydroaerodynamics" [*Ekspperimental'naya gidroaerodinamika*] (Moscow 1933): his work "Hydrodynamics of Turbodyamos" [*Hidrodynamicika turbomashyn*] was issued in Ukrainian in Kiev in 1959.

is now one of the finest experts on turbomachines, and, above all, on gas turbines. Thirty-seven years later he is the head of the newly created Department of Aerohydromechanics and Heat Exchange at the University of Kiev¹² and also the Institute of Thermal Energy (now the Institute of Technical Thermophysics) of the AN UkSSR.

O. Borysenko and I. T. Shvets are not exceptions in the process of forming a new generation of notable scientists in the field of aviation in the Ukraine. In 1929-1930, there appeared the first Ukrainian works of such current notable scientists as V. I. Tolubyns'kyy (Academician of AN UkSSR since 1964), O. M. Retaniv and V. K. Bernats'kyy (Phenomenon of Detonation from the Point of View of the Electronic Theory), or K. Kuz'myts'kyy (Aerodromes as a New Factor in the Construction of Populated Areas), and K. F. Cheplan (Internal Combustion Engines). The works of Retaniv-Bernats'kyy (who then worked in Kam'yants in the province of Podolia) are of special significance, since in them the authors study the question of gas ionization at the impact explosive moment. This is the main consideration in all current studies (i.e., studies of 1960-1968) on the phenomenology of combustion processes. The works of Retaniv-Bernats'kyy were published in many journals (in Ukrainian: "Ukrainian Physics Notes", Vol. 2, Copy 1, 1928; "Notes on Kamianetz-Podolia SHI", Vol. 1, 1928; "Scientific-Technical News", No. 10, 1929; in Russian: "The Journal of The Russian Physical-Chemical Society", Vol. X, No. 6) and they are considered pioneers in this field in the Ukraine.

It must be noted, that numerous researchers at Kharkov were active co-workers of VUAN, especially of its Physics and Mathematical Department. Frequently they published their works in VUAN publications. An example of

¹²In 1924-1926 there was an Aviation Division at the Kiev Polytechnical Institute (KPI); in 1926 it was closed, and until the creation of a separate Kiev Institute of Civil Aviation Engineers, aviation was a subject at Kiev University. We will discuss this further, when we speak about the work of Professor I. Ya. Shtayerman. Apropos, it was at the Aviation Division of KPI that the world famous Ukrainian designer of rockets and cosmic vehicles, Sergyy Pavlovych Korol'ov, began his studies (see *Vestnik*, AN SSSR, No. 7, pp. 206-212, 1967). One of the more detailed descriptions of the younger years of Korol'ov appeared (unfortunately in literary form) in the Kiev "Literary Gazette", 14 April 1967. (Sergyy Plachynda: Designer of Space Vehicles).

these proceedings included "Aerodynamic Studies", written by Professor Naum Illich Akhiezer, which was published in the Proceedings of the Physics and Mathematical Department of VUAN, Vol. VII, No. 2 (1928) and a series of lesser works by this famous Ukrainian scientist in "Notes" of the Physics and Mathematical Department, for example, "The New Development of Necessary Conditions Pertaining to the Entire Function of the Entire Order of a Given Type" (1927), the work concerning the Bernoulli polynomials (together with E. Shtayerman). Some works of Akhiezer were published in "Notes" in German. /79



Naum Illich Akhiezer
(photo from the 30's)



Illya Yakovych Shtayerman
(1891-1962)

Altogether, "Notes" carried on at that time the politics of popularizing the achievements of Ukrainian science abroad, and a series of works by Ukrainian scientists were published in "Notes" from 1927-1929 in French and German. In these "Notes" we note further the works of Professor I. Heronimus, some of them in Ukrainian, and some in French (for example, Sur l'erreur des quadratures mécaniques de Gauss) and reviews in foreign books (as "Les hélicoptères" of Professor Margulis). Outstandingly significant are the works of M. Kurens'kyy, moreover since they all used pure Ukrainian scientific terminology, and further, they concern themselves with important questions of aerohydrodynamics, and, in particular, they study the motion of solid bodies in liquids in cases of kinetic energy ("Notes", Vol. 2, No. 1; Vol. 3, Nos. 1 and 3). M. Kurens'kyy makes use of modern methods of mathematical physics analysis and elegantly solves the complex

problems of hydromechanics with the help of differential equations (linear in Jacobians) with partial derivatives of the first order.¹³

In "Notes" of the Physics and Mathematical Department of VUAN and also in the "Collections of Works" of the Institute of Technical Mechanics of VUAN (1926-1929) there appeared many works of two outstanding specialists in metallurgy and technological design of aviation motors from Kharkov, namely, Sergiy Volodymyrovych Serensen and S. S. Nekrytyy. S. Nekrytyy worked on the subject of fatigue of ingots of light aluminum alloys under repeatedly-changing stresses (together with I. I. Bokovoy), and on the selection of alloys for airplane motor pistons. Also, hardening of malleable cast iron was the subject of Nekrytyy's study. S. Serensen, although still young at that time, was an especially prolific researcher and author of many Ukrainian works. We shall mention here only a few such as "The Calculation of Additional Effects in Machines for Fatigue from All-round Flexing", "On Methods of Establishing Controlled Mechanical Properties of Materials", "Concerning the Vibration of Short Rods", and so on. S. Serensen was also published in the "Scientific-Technical News" of the Kharkov Scientific Association (for example the article "On Methods of Controlling Mechanical Quality", January 1929). As is known, S. Serensen later lectured at the Kiev Aviation Institute (1934-1941), and was a very active worker at the Institute of Construction Mechanics (to 1945). Evacuated during the war, Serensen unfortunately remained in Moscow where a series of honorary posts were proposed to him (director of the laboratories of the Institute of Machine Science of The Academy of Sciences of the USSR (AN USSR) and the Central Institute of Construction of Aviation Motors, Professor at the Moscow Aviation Technology Institute). However, even in Moscow, Serensen took an active part in the projects of the AN UkSSR, in which he was an academician from 1939. On the pages of the addenda to "The Scientific-Technological News", entitled "Problems of Thermal Technology",

¹³If it is a matter of mathematical physics, then in "The News" there also appeared many works of scientists such as M. M. Krylov, H. B. Pfeyer, M. Kravchuk and D. Grave; which by the way, were later also applicable to aviation technology.

there appeared an article by the above-mentioned young engineer-mechanic V. I. Tolubyns'kyi entitled "Nomographs with a Moving Field" (for the solution of thermotechnical formulas) and articles on problems of thermal power. It is important to note here something we have already mentioned, that is that the majority of our young scientists who were active in Ukrainian sciences in the later Twenties, especially those in aerodynamics, aeronautics and metallurgy, later became the backbone of the famous workers in aviation in the Ukraine during the Fifties and Sixties. As an example of the uninterrupted continuation of the work of these scientists, we shall list the editorial board of the Kharkov journal, *Aviation Construction and Techniques of the Air Fleet* (a quarterly issued since 1965), whose members are Professor Yu. K. Antonov, Assistant Professor L. L. Balashov, Professor A. I. Borysenko, Professor Ya. L. Heronimus, Professor I. P. Holdaiv, Assistant Professor P. V. Dybs'kyi, Assistant Professor V. A. Zemlyans'kyi, Professor L. A. Kolesnikov, Assistant Professor L. P. Lozyts'kyi Assistant Professor V. S. Maksymiv, Professor Ya. I. Nevyazhs'kyi, Professor A. M. Penkov, Assistant Professor Yu. P. Petrov, Professor Ya. E. Tkachenko, O. V. Floryns'kyi, Assistant Professor V. A. Khokhlov, Assistant Professor Zh. S. Chernenko, and Assistant Professor Yashkir. Many of the enumerated members of the editorial board began their work in the 1920's.

While recognizing that Kharkov played the major part in the organization of the scientific base for aviation affairs in 1925-1930, we nevertheless cannot omit the prominent role of Kiev.¹⁴ The beginning of studies in the branch of hydroaeromechanics (and heat exchange) in Kiev arose from the works of Academician D. O. Grave, in which he studied a series of general questions on the pressure of liquids, the motion of compressible and incompressible liquids, and, further, the physical foundations of cavitation. Therefore, a special emphasis is placed upon the application of theory to practice, namely to aircraft construction by Professor I. Ya. Shtayerman and also V. Ye. Dyachenko. /80

¹⁴We do not mention here the development in later years (the Thirties and Forties) when in Kharkov, Kiev and also in other cities of the Ukraine, a number of special aviation institutes and schools for fliers were begun.

The main theme of numerous earlier works by I. Ya. Shtayerman, who was a professor at the Kiev Polytechnical Institute (KPI) and also at Kiev University, was the fulfillment of the well-known studies of Maisner concerning symmetrically loaded rotation casings. Relative works of Shtayerman, which were based upon mathematical calculation (method of asymptotic integration of equations of the equilibrium of anisotropic casings) appeared in 1923, and in the following years he also published a series of works in Ukrainian (and in French) in "Notes" of the Physics and Mathematical Division of VUAN (for example, "Sur quelques formules d'interpolation convergentes pour toute fonction continue", "Quelques remarques sur les formules des quadratures dites mechaniques an point de vue de leur calcul effective", and others.) I. Ya. Shtayerman, among others, first investigated the problem of static contacting pressures of elastic bodies under particular conditions of their initial contact by undeformed surfaces. That question already goes beyond the scope of the classical theory of H. Hertz. As is known, Professor Shtayerman, in the Thirties, became Chief Editor of *Transactions*[Trudy] of the Kiev Aviation Institute, in which he also published a number of his works (but already in Russian). Professor V. V. Syneuts'kyi who was, like Shtayerman, a student of Professor Delone¹⁵ was well known in the Twenties because of his

¹⁵The development of the "family tree" of Kiev scientists in the field of mechanics, and especially of hydro and aeromechanics, is complicated and reaches many decades into the past. If I. Ya. Shtayerman and V. V. Syneuts'kyi are included as pupils of B. M. Delone, then Delone himself is considered a pupil of Dmytro Alexandrovych Grave (1863-1939). But in the formation of the scientific interest, for example of Shtayerman, an important influence came from the works of another noted Ukrainian mathematician, Petro Vasyl'ovych Voronets. Voronets died in 1923 and the majority of his brilliant works on motion equations of nonholonomial systems was published as early as 1897-1914. Having obtained these equations, Voronets quickly solved the question concerning motion without slide of a hard body on a immovable field, upon a spherical surface, and even solved the problem on the rolling of a free body on a free surface (in 1909). In studying the youth of P. Voronets we find that he in turn was a pupil of Havryl Kostyantynovych Suslov (1857-1935), who also worked in the Department of Mechanics of the University of Kiev over a period of 30 years (1888-1920). Suslov was a founder of studies on hydroscopic systems and the relation of the theory of potential in hydromechanics. In this manner, the ancestors of the so-called Kiev School of Mechanics in the forefront can be considered to be Academician Grave, then Professor Suslov, and even these two coryphaei were pupils of Ukrainian Kievan mathematicians who at this time were

pedagogical work in KPI, but also because of valuable reviews concerning literature of the design of motors in the Kharkiv "Scientific Technical News". It is necessary to emphasize here that many works of the Ukrainian scientists were being published in closed and secret publications, and they have not been released to this day. We have accurate information that such authors as Professor Syneuts'kyy, and also the aforementioned S. V. Gerngros, D. N. Ksandrov and S. V. Tarasenko were published in closed publications. As an example of the secrecy maintained on works of Soviet specialists on aircraft designs, among others, are the works of the Russian scientist Aleksandr Nilolaevich Lapchinsky, a long term director of the Department of Aviation of the Frunze Military Academy in Moscow. In 1926-1930, he wrote two notable /81 books which became textbooks for higher schools of aviation, namely, *Tactics of Aviation* and *Air Fighting*. In 1934 and 1937 he added two more important books, *Bombardment Aviation* and *The Air Army*. But in Soviet bibliographies, data on these books (and also on nearly 125 large articles and sketches by Lapchinsky) cannot be found. All these works are classified secret and it was not possible to mention some of them in the USSR until 30 years after Lapchinsky's death (he died in 1938).

Another Kievan scientist, Yu. D. Sokolov, began his research as early as 1921 (mostly on the subject of the stability of material systems and on the spatial homographic motion of free systems). His works much later were

not yet solving problems either of mechanics of solid bodies nor aero- or hydromechanics, such as M. Ye. Vashchenko-Zakharchenko, H. F. Voronyy, M. V. Ostrohrads'kyy and others. In spite of some new efforts by Ukrainian historians to establish the era of the development of Ukrainian science in the 18th and 19th Centuries (see History of the University of Kiev [*Istoriyu Kyivs'koho universytetu*] (collected publication) Kiev, 1961 or separate articles in the "Historico-Mathematical Collection [*Istoryko-matematychnyy Zbirnyk*] AN UkSSR (in 1958-1963 four issues were published) in the history of the development of mechanics and aeromechanics in the Ukraine there are yet many "white" unwritten pages). As an example we shall mention that almost no one knows about B. Globu-Milhaylenko, even though he is noted in the West as the author of one of the earliest works on the rotation of a fluid mass, which he published in 1919 (in French), or the scientist from Poltava, Vasilyy Stepanovych Machuhovs'kyy, a member of the "Russian Mathematical Society" since 1901.

adaptable to calculations of trajectories of flying objects.¹⁶ As in the case of Kharkov engineers and researchers, as well as in the case of those from Kiev, their main contribution was to publish many fundamental works in Ukrainian during the Twenties and especially in 1927-1930. Even those who worked as constructors and only occasionally on development clearly underscored the participation of their work in the Ukraine (K. O. Kalinin, I. H. Neman, V. O. Pysarenko, V. P. Yatsenko, O. Mykulyn, S. Hryzodubov and others). Many of the aforementioned scientists in the field of aviation continued to publish their works only in Ukrainian during the Thirties and up to the outbreak of World War II. Among them we must again list I. Ya. Shtayerman (most of his numerous works in *The Journal* of the Institute of Mathematics of VUAN in 1931-1939), Academician Grave, who in 1933-1939 published his works exclusively in Ukrainian (and also perhaps in French), Yu. D. Sokolov, B. Ya. Bukreyev (a mathematician, whose works on the variable multiples and the theory of spatial curves found wide adaptability in aviation construction). Some Ukrainian scientists (it is interesting to note that many were descended from Ukrainianized immigrants) also adopted another method of sharp protest against the attempts at Russification of Ukrainian science in the Thirties. They began to publish their works mainly in foreign languages. Thus, Ya. L. Heronimus printed his works in 1930-1936 almost exclusively in French (in "Notes" of the Kharkov Mathematics Society, in "Comptes Rendus" of the French Academy of Sciences). Many of his works were also published in English in London and American journals (Journal of London Mathematics Society, Transactions of the American Mathematics Society, Proceedings of the Society of Edinburg). N. I. Akhiezer¹⁷ in 1933-1935

¹⁶ Investigations of such successful scientists in the field of mechanics as O. Yu. Ishlyn'kyy, M. M. Krylov, M. M. Boholyubov, Yu. O. Mytropol's'kyy, A. D. Kovalenko, M. O. Kil'chevs'kyy, H. M. Savin, H. M. Polozhiy, M. O. Lavrent'ev first began in the Thirties, but blossomed in the Forties and Fifties; therefore, we do not mention them here in detail.

¹⁷ Reference here is to Naum Illich Akhiezer (born 1901), a mathematician; in 1933-1941 he was a professor at the Kharkov Aviation Institute; following the war he returned to Kharkov in 1947 to the post of professor at the University of Kharkov. Also active in the Ukraine is the brother of Naum Illich - Oleksandr Illich Akhiezer (born 1911), a physicist. Both are members of the AN UkSSR.

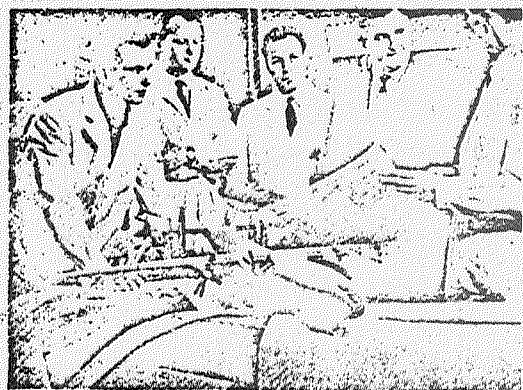
published almost all his works in German. (In "Notes" of the Kharkov Mathematical Society). Also, B. N. Delone published his works in 1929-1934 mostly in French and German (*Reports [Izvestie]* of the AN USSR). This method was also adopted by such brilliant Ukrainian scientists as M. M. Krylov and M. M. Boholyubov. The great majority of their colossal scientific production from 1930 to 1939 was published in French. Nevertheless, it is important to note that the most important of their works of that period were published in Ukrainian (in "Notes" of VUAN, 1925-1929; "Notes" of the Department of Mathematical Physics of AN UkSSR, 1937-1939; in the "Collections of NTSh", 1926-1928; and individual pamphlets such as M. M. Krylov's "Basic Problems of Mathematical Physics and Techniques"; scientific investigations of practical mathematics, State Technical Publishers [*Derzhtechvydav*], (NTP) Kiev-Kharkov, 261 pages, 1932; M. M. Krylov: "Lectures on Approximate Calculations," NTP, Kharkov-Kiev, 392 pages, 1932; his "Methods of Approximate and Symbolic Solutions of Differential Equations of Mathematical Physics and Technology", NTP, Kiev, 162 pages, 1931; or M. M. Boholyubov: "New Methods of Variable Calculations", *Techteoretvydav*, Kharkov-Kiev, 1932; his "On Some Formal Disclosures of Nonlinear-Mechanics", AN UkSSR, Kiev, 89 pages, 1934 (his well-known "Lectures on Quantum Statistics" were published following the war in "Radyans'ka Skola" publishing house in Kiev, 1949).¹⁸

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From the above illustrations we can clearly see that the foremost place in the development of aeronautical activity in its initial stages in the Ukraine (the Twenties to the beginning of the Thirties) was naturally occupied by Kharkov and Kiev. Their position was later strengthened, especially when separate aviation institutes on the university level were organized, in these cities along with special military high schools, for pilots which began to publish their own "Scientific Notes and Works". However, even in the late

¹⁸To what extent Russification of Ukrainian science was achieved in the period from 1930 to the 1960's, we can see from the fact that in 1969 the publishing house Naukova Dumka [Scientific Thought] in Kiev started, "upon the decision of the Presidium of the AN UkSSR", to publish the complete works of M. M. Boholyubov; the first volume of these "Works" (which has already appeared in print) encompasses the works of the scientist, published in 1930-1941, and all of them are translated in the new publication into Russian (from the Ukrainian and French of the original, as is stated in the preface to the "Works").

Twenties and in the Thirties a number of brilliant Ukrainian specialists on aviation worked not in the Ukraine, but in Russia, especially in Moscow. An especially large group of our scientists was engaged in TsAGI (The Central Aerohydrodynamic Institute; at the time located at 21 Voznesenskiy Street in Moscow, but its laboratories were scattered around Moscow and its suburbs).¹⁹ Being responsible workers of TsAGI, our scientists, most frequently holding two or more jobs, were at the same time lecturers and professors in the Military Academies in Moscow. These new forces came upon the generation change of B. M. Lobach-Zhuchenko and V. L. Moysiyenko and others, whom we mentioned in the beginning of our work, with this difference,



Designer Oleg K. Antonov (in the dark suit) with co-workers (of the section) N. Tabolin, M. Petrenko, E. Kozlov and M. Truchenkov.

that the new forces were somewhat better acquainted with the leading theories and their works were characteristically on a very high scientific level. From the notable group of Ukrainian workers at TsAGI, we would like first to mention A. N. Zhuravchenko, V. P. Hors'kyy, A. I. Mykytyuk (often appearing in Russian sources as A. I. Nikityuk), H. A. Hurzhiyenko, I. Ya. Lysenko, and V. H. Mykolayenko. I. Ya. Lysenko and V. H. Mykolayenko were among the earliest co-workers at TsAGI. As early as 1926 Lysenko published the results of his investigations on knocks in

airplane motors. Later he switched to investigating propellers, on which he published "Samolet" and "TVF" in 1931. V. H. Mykolayenko studied the effect of the weight of aircraft and its drag resistance on aerodynamic flight properties ("Technical Comments of TsAGI," No. 53). O. N. Zhuravchenko is the author of

¹⁹TsAGI [The Central Aero-Hydrodynamic Institute] was founded on December 1, 1918. In the beginning the Institute had only a research-aerodynamic laboratory, a division of design prototypes (AGOS) and a division of motors. The scientific-research personnel of TsAGI in 1919-1920 hardly consisted of forty persons. In later years the Institute grew rapidly, especially in May of 1924 with the construction of the new wind tunnel near Moscow, and in 1935 new larger laboratories of the Institute were constructed. It is important here to add that already in 1930-1932 some sections of TsAGI were transferred into separate independent institutes, for example, The All-Union Institute of Aviation Materials (VIAM), The Central Institute for Construction of Aviation Motors (TsIAM), The All-Union Institute of Hydromachine Construction (VIGM), and The Central Wind-Energy Institute (TsVEM).

certain works on the horizontal resistance with and without a compensator, by analogies in research with models, and on static longitudinal aircraft stability. In later years (1934-1936) Zhuravchenko became well known for his works concerning the corkscrew effect when he discovered how to solve the problem of aircraft stability under unusual loss of speed, and further with the calculation of the radius of the corkscrew trajectory (in the supercritical region; see *Trudy* of TsAGI, Nos. 167, 200 and 260). Generally, Zhuravchenko has priority in detailed scientific studies of the dangerous corkscrew effect both in Soviet and in world literature. H. A. Hurzhiyenko, even though he already worked in TsAGI from 1931 to 1932, began publishing his works in 1934-1936. They pertain, first of all, to problems of overcasting smooth aerodynamic profiles at great Reynolds speeds (see *Trudy* of TsAGI, No. 257). In the solution of this problem, Hurzhiyenko adapted a universal logarithmic law of the distribution of speeds in limited boundary layers. In such a manner he also became a pioneer in the investigation of aerodynamic phenomena of boundary layers, which immediately played a primary role in calculations of flight (and in design in general) of present day high-speed and supersonic aircraft. In later years Hurzhiyenko also investigated the effect of the viscosity of fluids on the laws of turbulent currents in cylindrical, smooth tubes (*Trudy* of TsAGI, No. 303).²⁰ /83

²⁰Contemporary Soviet sources are silent concerning the activities of Hurzhiyenko except for a brief characteristic of the earlier works of V. L. Moysiyenko, A. N. Zhuravchenko and B. T. Horoshchenko, first given in an article on engineering development and other technical studies by R. Vinogradov, entitled "Aviation Science and Progress in Airplane Construction" [*Aviatsionnaya nauka i progress samoletostroeniya*] (At the sources of our aviation and astronautics), the journal *Aviation and Astronautics* [*Aviatsiya i Kosmonavtika*], No. 6, pages 18-21, June 1968.

The newest studies (carried out, by the way, abroad and not in the USSR) have shown that Zhuravchenko was active before World War I. For example, he appears to be the inventor of a system for loading bombs in the "Illya Muromets" airplane designed by Igor Ivanovich Sikorskiy in 1915. A number of these airplanes became part of the so-called Squadron of Air Ships (*Eskadr Vozdushnykh Korobley=EVK*) which in 1917 was stationed in Venice. One of the prototypes of the Illya Muromets IM-B carries the official designation of the Kiev IM-B, but it was built in Petersburg. Some of the later models of the IM were built at the factory in Riga (Russian-Baltic Car Factory [*Russko-Baltiyskiy Vagonnyy zavod*] one of the first factories on the territory of former Tsarist Russia that built planes from 1915 to 1917. (See Alex Vanages: *First of the Giants, Flying Review International*", pages 60-63, December 1968).

A. I. Mykytyuk (who worked together with Zhuravchenko in the late Twenties) independently published in 1931 the calculation of moments of inertia for aircraft (*Trudy* of TsAGI, No. 94). V. P. Hors'kyi was also an assistant of Zhuravchenko. He worked with him on problems of horizontal resistance and side sweeping of hydroaircraft.

On of the most honored and active specialists in the field of aviation, whose activity began in 1929-1930, was B. T. Horoshchenko. In TsAGI, Horoshchenko worked closely with later well-known scientists and designers such as S. V. Ilyushin and M. K. Tikhonravov. The works of Horoshchenko are distinguished especially by their high level and reasoning; his works are valuable for their analytical methods of calculating stability and balance of aircraft (printed in the collections *Airplane Construction*, TVF) and on aerodynamics of gliders, see the journal *Samolet* [The Airplane], 1930-1931, "Library of Aviation Engineering". Horoshchenko is also the author of two textbooks: *Influence of Regulation on Flight Properties of Aircraft* and *Construction Forms of Present Day Aircraft* (both books published in 1929).²¹ Simultaneously with Horoshchenko in 1930-1931 a group of lesser known specialists began their activity, such as A. P. Kuzhma (see his book *Thermal Processes in Aviation Motors*, Leningrad, 1931), and I. Babyuk, author of numerous articles on flying models in the journal *Samolet* in 1930-1931. We have totally insufficient data on N. V. Pastushenko, H. Myklashevs'kyi, I. Osypenko and V. Potapenko, who wrote for VVF in 1926-1931.

It is important to mention, even if briefly, the activity of the specialists who worked directly on aircraft construction or contributed to it. We would like to give credit to individual activists in this field, but we encounter great difficulties due to the secrecy of the relative Soviet data. We only know that in the Twenties the main center of aircraft construction in the Ukraine was the aviation plant in Kiev. The foundations of this plant were begun in 1918 and were considered to be great repair shops. In the early Twenties this plant bore the title "*Remzavod-6*" [Repair factory-6] but near the end of the Twenties it was enlarged to include the building of gliders and six to ten seat passenger planes of the KhAI type, designed in Aviation Institute by a group headed by Professor

²¹Horoshchenko also continued his activity in the later Thirties, which we plan to discuss in another article.

I. H. Neman. The KhAI-1 was one of the better passenger planes in the first half of the Thirties. Its M-22 motor with 480 hp made possible speeds of up to 300 km/hr. The plant was engaged in a great undertaking after 1933 when it was classified secret (it received the title of Factory No. 43 from the Commissariat of Defense) and it was assigned to assemble military planes.²²

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Another important step in the age of establishing aircraft construction in the Ukraine was the motor construction factory in Zaporozhye. It was established in 1916 and observed its 50th anniversary in 1966. In 1926 in this factory the first series M-11 motor was built with 110 hp, designed by A. D. Shvetsov. This motor was produced continuously until 1935. It was also built following World War II, which is evidence of the quality of the motor, (for example in Poland; types M-11-D and M-11-FR, see *"Biuletyn Informacyjny Instytutu Lotnictwa"*, May-June, 1967, No. 3(20), page 24). In 1928 the development of the M-6 motor began; it was water cooled, 300 hp, and weighed 275 kg. In 1930 construction began on the star-shaped M-22 motor with 480 hp. Motor power was constantly growing, so that in 1935 an M-25 motor with 635 hp, and in 1938-1939 an M-88 motor (two series) with 1100-1200 hp were manufactured. The M-6 motor was built with a license from the Hispano-Suiza firm, and the M-25 motor upon licensing of the French type Gnome-Rhone. The most noteworthy heads of the Zaporozhye factory from 1920 to 1930 were M. M. Lukyn (director), O. Balandyn (chief designer), and the noted designers A. D. Shvetsov and S. K. Tumans'skyy. As to the Soviet aircraft factories being (successfully) classified secret, this is supported by the fact that even in 1955 one of the most important American monographs concerning the aviation industry in the USSR "confused" the Zaporozhye factory with factory No. 24 (in Moscow), and credited the Moscow factory with the construction of the M-11 motors (see *"The Soviet Aircraft Industry"*, University of North Carolina, Chapel Hill, 1955). This is

²²As was mentioned in earlier works (see for example *"Visti"* [News] of the Society of Ukrainian Engineers [*Tovarystvo Ukrain's'kikh Inzheneriv*], No. 92-93, July 1966) already before World War I prototypes of planes and motors were built in the Ukraine (for example, the activity of Yu. Sikorskiy and O. O. Mykulyn). Actually, they were custom-built in amateur shops.

even more unusual, since as early as 1953 the Zaporozhye factory was described fairly accurately by one of its chief technical workers, who left the USSR and immigrated to the U.S.A. His publication (Personal Experience in a Plane Engine Factory in Zaporozhye after World War II) should have appeared in the cycle of works which were financed and published by what is known as the East European Foundation, Inc. [Research Program on the USSR], established by the Ford Foundation in March 1951. But in violation of the author's conditions and legal principles, the management of the above-mentioned publication removed the submitted work from circulation and it has remained secret.

Other active Ukrainian designers of aircraft from 1925 to 1933 were B. I. Cheranovs'kyi [Bych-7 airplane (1930)], A. M. Gratsiyans'kyi [Omega (1933)], and somewhat later N. Sydorenko [TAK, (1936)], O. Katsura [VO-4 (1936)] and V. P. Yatsenko [DY-6 (1937)].²³ Dmytro Pavlovych Hryhorovych (1883-1938) was one of the more well-known and honored Ukrainian designers. Unfortunately he worked mostly in Russia; thus, in 1925-1928 he was chief engineer of factory No. 39 (named after Myenzhyns'kyi), and in 1932-1935 became a professor in the Moscow Aviation Institute and headed the famous experimental design bureau (KB). Noted creations of Hryhorovych were the aircraft MU-1, MU-2, MU-4, M-20, M-24, ROM-1, ROM-2 and others. Concerning the noteworthy designers Kalinin and Antonov, already mentioned several times, it seems necessary to only mention that from 1926 to 1936 Kalinin created a whole series of successful prototypes of aircraft; among these were the K-2, K-3, K-4, K-9, K-10, DK-1 and K-5. It is important to note that the more able designers deserve a separate study and separate monographs; all the more so, because Soviet Russian authors like, as we have already mentioned several times, to purposely silence the achievements

²³ In detail the designs of Volodymyr Yatsenko (the aircraft DY-6 was built, apropos, in large numbers; it was famous in battles in the region of the Khalkin-Gol River in Manchuria, 1939) and Oleksandr Yakovych Bereznyak (his jet fighter plane BY-1 achieved a speed of 900 km/hr) were already active in 1936-1941 and we cannot include them here.

It is useful to note that one of our first aircraft designers was Viktor Osypovych Pysarenko, who in 1922-1923 planned and built (in the shops of the Sevastopol Aviation School) an aircraft, named for him, which was successfully tested on 27 November 1923. In 1925 Pysarenko was transferred to Moscow where he designed sport planes ("Aviation and Astronautics", No. 1, 1969).

of Ukrainian scientists. For example, it is very important to find more detailed data on the designers of aviation motors, Arkhyy Mykhaylovych Lyul'ka /85 and Oleksyy Illapionvych Shvedchenko. We know only that Lyul'ka graduated from the Kiev Polytechnical Institute in 1931, and in 1933-1939 he worked in the Kharkov Aviation Institute. For his brilliant development of plans for jet motors he twice received the Stalin Prize (in 1948 and 1951), but, it is difficult to learn where he worked following World War II and also in which aircraft his designs were used (their exact characteristics are not known), in spite of the fact that he became an associate member, and in 1968 an Academician, of the AN USSR. Shvedchenko also received the Lenin Prize in 1960, but other data are lacking on his activity. Nevertheless, both belong to the other generation of Ukrainian designers - Lyul'ka was born in 1908, and Shvedchenko in 1921, and they worked in the Soviet aircraft construction for several decades. The only uninterrupted data show that at one time they were noted workers in the designing bureau of factories No. 24 (named after Frunze), No. 22 (named after Gorbunov), No. 28 (named after Ordzhonikidze), and No. 153 (named after Chkalov).²⁴

As for aviation factories in the Ukraine, they are considered (but not quite accurately) only as assembly-fitting factories and also factories of aircraft motors; we therefore originally mentioned the Kiev and Zaporozhye

²⁴In our article we will not dwell on recollections of famous Ukrainian fliers, particularly test pilots of aircraft prototypes, who together with the designers deserve mention for introducing new types of aircraft. From the cadres of these fliers there later emerged many generals and marshals of aviation of the USSR; also, almost all leaders of USSR civil aviation came from the ranks of pilots.

factories.²⁵ Actually, all plants and factories which build the various component parts for aircraft belong to the aviation industry. There are many such subsidiary factories in the Ukraine and some of them were already active at the turn of the Twenties and Thirties. The more complex the construction of aircraft became, the more subsidiary factories were included in the selective program. Immediately the situation was such that in the manufacture of modern aircraft (in large numbers) the participation of hundreds of factories (with full specific load) was accepted. The aviation or aircraft construction plant of such title only assembled planes from parts sent from all over the country and tested their flight properties.

For a complete picture and for objectivity it must also be mentioned here that from the Twenties to the Thirties some foreign specialists, especially German engineers worked in the scientific-research establishments of the Ukraine in the field of aviation.

It is not our intent to list their names, the majority of whom returned to Germany in the second half of the Thirties.²⁶ Many of them later became well known (especially during World War II) in the field of German aviation and rocket design, and also generally in the physical-technical sciences. Only as a characteristic example shall we mention that one of the most unusual specialists of cryogenic technology in the West, Professor M. Ruheman, worked

²⁵In later years the great new Kharkov Aviation Plant also became famous, in which plant powerful modern jet passenger planes were built, such as the TU-104 and TU-134 (see *Skrzydłata Polska*, No. 22 (829), page 20, May 28, 1967). We will not mention here the new factories for building military aircraft.

Data on the work of Ukrainian aircraft construction production is more frequently found in foreign sources (for example, Polish, Czech) than in Ukrainian Soviet ones. On account of this, the airplanes TU-104, TU-124 and TU-134 that are built in Kharkov are mentioned by Yuriy Gregozhevski in his article "*Radziecki przemysł lotniczy*", *Biuletyn Informacyjny Instytutu Lotnictwa (BILL)*; No. 29, 1968.

²⁶The chief representative for engineers of aircraft construction affairs in the USSR was, at that time, Dr. Oskar Ritter von Nidemayer, who was active in the USSR under the name of Neyman from the *Deutsche Heeresleitung*, Z. Mo. The specialists of the firms, Daimler, Junkers, Rheinmetal and others, were subordinate to him.

from 1932 to 1937 in the low-temperature laboratory of the Physical-Technical Institute in Kharkov (currently he is the Director of the Division of Low Temperatures in the English firm, Petrocarbon Ltd.).

The names of such scientists as Shtayerman, Grave, Gerngros, Neman and others, whom we have already mentioned, speak for their German origin. However, during their activity in the Ukraine in the Twenties and Thirties, they were completely Ukrainianized and considered themselves to be Ukrainian scientists.²⁷

Thus, we have shown in this article separate stages of aviation develop- /86
ment in the Ukraine during the Twenties and Thirties. Around 1934 there began a new era in the field of aircraft construction in the USSR. The clouds of approaching war gathered over Europe. Therefore, in the USSR work on aviation construction and in all scientific activity related to war technology was increased. At the same time, these works were made more secret, and the majority of them remain secret to this day. Ukrainian scientists and engineers played an even greater role in all fields of research. In contrast to the situation of the 1920's, Ukrainian scientists and designers found it ever less possible to work directly in the Ukraine. Such a well-known designer as K. A. Kalinin (and others) were brutally liquidated by the regime in 1937-1938, and others (for example, A. N. Lyul'ka, S. K. Tumans'kyi) were transferred to Moscow. The fate of Lyul'ka and Tumans'kyi was shared by many of VISH's new aviation graduates of the Ukraine. Our forces were scattered to the winds and their work was attributed mainly to achievements of "Soviet" science, and frequently

²⁷In addition to German engineers, other foreigners also worked in the aerodynamic and aircraft construction field in the Ukraine and they deserve our gratitude. For example, there was Volodymyr Fomych Brecka (W. Brecka), the assistant and co-worker of Ya. L. Heronimus. Brecka was a Czech; he published numerous works on monotone polynomials (see Visnyk of the Kharkov Polytechnical Institute, No. 2 (50), pages 56-61, 1965).

of Russian science.²⁸ However, even here the burden of Soviet silencing and twisting slowly becomes clearer. We note the attempts of historians of technological development in the Ukrainian Soviet Socialist Republic to give more detailed information concerning the contributions of Ukrainian scientists and engineers in the development of technical science, including the science of aeronautics. We are hopeful that soon the picture of the situation in the years 1932-1950 will become clearer and more accurate, at least as much so as the picture of 1950-1969, when, on account of international scientific connections, silencing becomes much more difficult to practice as in the dismal fame of the "Stalinist" years.

²⁸One interesting aspect of Russian chauvinism was disclosed recently by the American journalist and expert in Soviet affairs, Harry Schwartz. He noted that Russians are exclusively selected as cosmonauts in the USSR up to now for the purpose of making only Russians the heroes of cosmic research. The only exception was Popovych who was selected, upon the intervention of Khrushchev, for pseudo-propaganda values, and he was clearly identified as a Ukrainian. It is possible that there are other Ukrainians in the fold of Soviet cosmonauts. For example, we have information that Beregov is also a Ukrainian, but official communiques in the USSR do not mention a single word about this, and in world opinion they wish to evoke the impression that cosmonauts are only Russians. Moreover, Schwartz criticizes Americans for this same thing saying that U.S. astronauts are exclusively persons of pure Anglo-Saxon ancestry; see the New York Times of May 19, 1969.

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